

TB MED 110

WAR DEPARTMENT TECHNICAL BULLETIN

USE OF DDT AS INSECTICIDE TO KILL ADULT MOSQUITOES*

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1. GENERAL. *a.* The purpose of this bulletin is to reemphasize the value of DDT as an adult mosquito insecticide and to urge its prompt and widespread application throughout all theaters and commands where mosquito-borne diseases constitute a menace to the health of the U. S. Army forces.

b. During the past several months extensive field experimentation has repeatedly demonstrated the value of DDT as a residual spray in killing adult mosquitoes. When DDT solution is sprayed on interior surfaces a residue is left which will kill insects lighting on the treated areas for periods of several months. Only a few minutes contact is required. The effect on the insect is delayed, however, and death may not take place for some hours. Use of DDT residual spray is the first method thus far developed which offers an efficient and easy

procedure for long-time destruction of mosquitoes infected with malaria, filaria, and other disease agents, especially when applied to dwellings of native carriers.

c. Since the destruction of infected adult mosquitoes constitutes the most effective break in the chain of transmission of malaria and other mosquito-borne diseases, use of DDT solutions for their residual effect is considered one of the most important applications yet developed. This method of employment of DDT should be given high priority in those theaters and commands where such diseases threaten the health and efficiency of the U. S. Army forces. It is emphasized, however, that DDT residual spray is to be regarded only as an adjunct to the usual insecticide spraying of tents and barracks. It must not be relied upon as the sole method to protect the occupants from malaria-carrying mosquitoes. Aerosol bombs should be employed routinely, and screening and use of bed nets should not be neglected.

2. PREPARATIONS OF DDT AVAILABLE FOR USE AS INSECTICIDE TO KILL ADULT MOSQUITOES. *a.* Preparations of DDT suitable for residual effect as listed in War Department Circular No. 151, 1944, as Quartermaster items, are quoted in the order of their ease of application and usefulness. They may be procured in the allowances set forth in the above-mentioned circular.

*This Supply Bulletin supplements information contained in TB MED 14, 8 March 1944.

Stock No.	Item	Unit
51-I-305----	Insecticide spray, DDT, Residual effect.	Gallon.
51-L-120----	Larvicide, DDT, powder, dissolving.	Pound.
51-L-122----	Larvicide, DDT, powder, dusting.	Pound.

b. Insecticide spray, DDT, residual effect, represents the finished product ready for use. Present allowances of this item were established primarily for fly control. For mosquito control an identical preparation can be obtained by making a 5-percent solution of larvicide, DDT powder, dissolving, in kerosene, the powder being more readily soluble in crude than in highly refined white kerosene. Larvicide, DDT, powder, dusting, must be used as a dust and is not highly recommended for its residual adult mosquito-killing properties but may be used where spray is not available or its application is impractical.

3. DOSAGE AND TECHNIQUE OF APPLICATION OF DDT AS RESIDUAL INSECTICIDE IN BARRACKS, TENTS, AND OTHER DWELLINGS. a. The purpose of using DDT as a residual insecticide is to form a deposit that will kill insects which rest or crawl over the treated areas for long periods after treatment. To employ this method of control effectively, the habits of the local vector mosquitoes must be understood. After feeding, many mosquitoes are found to rest indoors for variable periods prior to their migration to sites of ovipositing. Under such circumstances residual spraying of native dwellings and military quarters will yield maximal results. In instances where the species to be dealt with is shy in its habits and prefers sylvatic resting places, the spraying of vegetation in and around the encampment will prove to be an expedient method in reducing the adult mosquito population.

b. (1) DDT as a residual spray may be applied by a number of methods. Where available, a gasoline engine compressor type of paint-spraying unit will offer the easiest and most effective means of application. Since kerosene is a fluid of much lower viscosity than that for which the apparatus was designed, the motor should be throttled down and operated so as to

develop from 10 to 15 pounds of pressure per square inch. The unit may be mounted on a truck, jeep, or other means of conveyance to facilitate mobility.

(2) Knapsack sprayers, as available from the Corps of Engineers, also offer easy means of rapid application but present the disadvantages of frequent leakage and difficulty in producing a spray of satisfactory droplet size. Where available, a Chemical Warfare Service open-head type of decontamination sprayer (decontamination apparatus, 3-gallon) will prove advantageous over the ordinary knapsack sprayer. In using a knapsack type of sprayer, a disk opening of No. 60 standard wire gauge is recommended.

(3) Although tedious and time-consuming in large-scale operation, the flit-gun type of hand sprayer will be found to produce a more satisfactory means of application than that mentioned above. It has the added advantage of universal availability. The 2-quart capacity, continuous-action hand sprayer will prove most satisfactory, although even the 1-pint, single-action flit-gun may be employed.

(4) The droplet size should be moderately coarse. If too fine a spray is used the material will drift throughout the room, whereas if the spray is too coarse, large droplets will fall to the floor before reaching their objective.

(5) Solutions of DDT may be applied by hand, preferably using a paint brush, where other equipment is not available. This method is the most economical means of application on wire screens, mesh surfaces, light cords, etc.

c. Dosages varying from 25 to 200 mgm per square foot of DDT have been variously suggested but to date no unanimity of opinion as to the most economical and effective amount exists. Until better information is available, it is recommended that DDT residual spray be applied in dosages of 200 mgm per square foot. This represents 1 quart of the 5-percent spray solution per 250 square feet, and may be expected to provide a residual effect up to 3 months on interior surfaces. Where sprayed surfaces have been painted or whitewashed, the persistency may be lessened. In every instance, close observation should be made to determine the necessary frequency of reapplication as well as the desirability of increasing, or possibly diminishing, the dosage.

d. In applying 5-percent DDT residual spray the nozzle of whatever type of sprayer is employed should be held approximately 1 foot from the surface to be treated. The area should be sprayed to the point of wetness but not to the state where there is a trickling off of excess. Spraying should be done horizontally, keeping the nozzle parallel to the surface. It should be recognized that the mere presence of DDT exerts no repellency. All surfaces where mosquitoes are likely to rest must therefore be treated. Special attention must be given to ceilings, corners, closets, and the under surfaces of chairs, tables, and beds. The solution is best applied to mesh surfaces (screen doors and windows) and to such objects as light cords, etc., by means of a paint brush. Other insects coming in contact with the residue of DDT will be destroyed, thereby offering additional results in the control of flies, bedbugs, roaches, and other insect pests.

e. (1) Although used successfully experimentally, DDT powder is not considered as efficient as the spray for use indoors as a residual insecticide. It is more difficult to apply economically. When spray is not available powder DDT preparations may be used as recommended below.

(2) One part of Larvicide, DDT powder, dusting, (which contains 10 percent DDT), should be diluted to a 2-percent mixture by mixing with 4 parts of any suitable diluent dust. Powdered talc is recommended, but powdered soapstone or even road dust may be used if necessary.

(3) The most suitable item of equipment available for indoor dust dissemination is the duster, insect power, plunger type (QM Stock. No. 41-D-3750). In most instances the rotary type hand duster commonly employed for larviciding will be found too cumbersome and too wasteful for indoor use.

(4) To powder a dwelling it is recommended that the surfaces to be treated first be wet down with water. The duster should be held with the nozzle approximately 1 foot from the surface and directed upward or downward at a 25° angle. Efforts should be made to standardize the force and rapidity of each stroke by the operator so that even coverage may be obtained. Approximately 3 pounds of the 2-percent mixture will be required per 1,000 square

feet, a dosage of 30 mgm of DDT per square foot.

(5) The use of DDT powder as a mosquito insecticide indoors has not had sufficient study to permit statements as to its efficiency or persistence. Careful observations should be made where this method is employed. As stated previously, use of DDT solution is preferable.

4. USE OF DDT INSECTICIDE OUT OF DOORS.

a. DDT in 5-percent solution in oil or kerosene distributed out-of-doors has not only direct killing effect on adult mosquitoes resting in vegetation and other hiding places, but also may exert residual action on insects that later fly into and rest in treated areas. The degree of residual action will depend largely upon the dosage of DDT applied and weathering factors. Out-of-door spraying of DDT solutions may be used in circumscribed areas to protect bivouacks, gun emplacements, observation posts, out-of-door motion picture theaters, and other gathering places. It may also be used for large-scale area control by employing mobile power equipment on the ground or by dissemination from aircraft. Effect on the density of mosquitoes should be noticed in about 20 to 30 minutes after spraying, but complete results may not be obtained for some hours. Temporary reduction of the mosquito population is obtained with a dosage of 1 quart of 5-percent solution (0.1 pound of DDT) per acre. Higher dosages are required for residual effects. Under favorable circumstances dosage at the rate of 0.5 pound of DDT per acre has remained effective for several days to a week. Much larger doses, 2 to 4 pounds of DDT per acre (about 5 to 10 gallons of 5 percent solution), have given residual action for 2 to 3 weeks, but, in order to conserve materials, such large amounts should only be used in circumscribed areas. Heavy rainfall and other weather factors may have an adverse effect on residual action.

b. The most efficient method for large-scale outdoor distribution of DDT yet devised is by airplane. Using the Husman-Longcoy type of spray equipment developed for the Cub (L4) airplane by the U. S. Department of Agriculture in conjunction with the U. S. Army Air Forces, or using the Chemical Warfare Service M-10

Smoke Tank applied to larger, faster planes such as the A-20 or B-25, wide and efficient coverage may be obtained. An oil solution should be used and care taken to insure complete coverage. This method has the advantage of yielding excellent larviciding effects as well as a toxic action on adult mosquitoes in the treated areas. Spray apparatus for use in airplanes has not been standardized as yet and its use is still experimental.

(1) Using the Cub-type plane, spraying should be accomplished at an altitude of 25 feet and at a speed of 70 miles per hour. The plane should fly cross wind, with strict attention to drift. Employing this technique, a swath of 40 feet will be obtained with each run and 2 quarts of spray will be released to the acre (0.2 pound of DDT when 5-percent solution is used). Care must be taken to allow for some overlap of each swath. Best results are obtained when there is little or no wind.

(2) Where faster and heavier planes are employed the spraying should be performed at 100 feet altitude and at 200 miles an hour or less. An effective swath 1,800 feet long and 200 feet wide may be obtained from the contents of one M-10 tank.

(3) The dissemination of DDT solutions by airplane has not been completely perfected. The exploitation of this method using other types of aircraft, tanks, and techniques is to be encouraged.

c. Where airplane spraying is impractical, good results in reducing the adult mosquito population may be obtained by spraying 5-percent DDT solutions in oil with a motor-driven paint sprayer or hand-operated knapsack sprayer. This procedure may be incorporated in the weekly larviciding program. Treatment should be accomplished by spraying horizontally into the air at waist height as the operator walks back and forth through the area, making swaths of 20 to 40 feet, depending on density of vegetation and wind velocity. The spraying should be done cross wind, beginning on the windward side with due allowance for drift. A 60-gauge disk opening should be employed to produce a fog spray. Care should be taken to spray under bridges, culverts, and other likely outdoor resting places.

d. Where it is desired to protect a small area such as a bivouac or an outdoor gathering place, all the territory within at least 10 yards of the periphery of the site may be satisfactorily cleared of mosquitoes by careful and complete treatment. If necessary, a hand-operated continuous-action flit-gun type of sprayer may be used, and special efforts at complete coverage should be made. Where benches have been constructed, the undersurfaces and ground beneath should receive careful attention. It is recommended that this procedure be repeated at least 2 hours prior to each time the outdoor gathering place is used.

5. CAUTIONS IN USE OF DDT. a. The toxic effects of DDT have been discussed previously (TB MED 14, 3 March 1944), and require no further elaboration.

b. Undue optimism as to the value and properties of DDT as a cure-all of mosquito-control problems is to be discouraged. DDT is not a panacea. *Unrelenting observance of all aspects of malaria control is mandatory*, to which we may expect DDT to add significant improvement in results. DDT exhibits its toxic effect by absorption through the cuticle of the feet, proboscis, or body of the insect, resulting in lethal damage to the nervous system. This effect is achieved slowly and from 2 to 12 hours may elapse before the insect dies. Recognition of this fact emphasizes the need for continued systematic employment of the aerosol bomb, protective clothing, screening, and maintenance of living quarters, use of bed nets and other aspects of malaria control included under the term "malaria discipline."

6. RECOMMENDATIONS IN USE OF DDT AS ADULT MOSQUITO INSECTICIDE. It is recommended that the use of DDT as a residual insecticide for adult mosquitoes be given high priority in the utilization of this agent in theaters where malaria is a problem.

a. In those areas where a heavily infested native reservoir must be dealt with and where vector species prefer indoor resting places, the treatment of native dwellings should take precedence over other uses followed in order of priority by the treatment of U. S. Army forces

domestic installations (barracks, day rooms, mess halls, tents, indoor latrines, etc.), and the larviciding and spraying of vegetation in and around camp sites.

b. In those areas where a native reservoir does not present an immediate threat or where a species preferring out-of-door resting places is encountered, the treatment of U. S. Army forces domestic installations and employment of DDT as a mosquito adulticide out-of-doors should be given first consideration.

c. In units heavily seeded with malaria transmission of the disease to noninfected individuals may be considerably reduced by the treatment of barracks, tents, latrines, and other buildings in the installations concerned.

7. SUMMARY. a. Although much additional work of an experimental nature is desirable, the urgency of need demands prompt and widespread utilization of DDT in the control of insect-borne diseases, especially malaria. Careful studies should be made of the results, attempts at

improvements of techniques encouraged, and observations should be reported through channels to The Surgeon General.

b. The potential value of DDT as an adult mosquito insecticide is so great that its utilization in this manner might well be given first consideration over other and more dramatic uses of this insecticide in malaria control.

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BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,

Chief of Staff.

OFFICIAL:

J. A. ULIO,

Major General,

The Adjutant General.

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